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PASTURE AND HAY CROPS FOR THE SOUTHERN CANADIAN PRAIRIES

BY

M. R. Kilcher, R. W. Lodge,
D. H. Heinrichs and J. B. Campbell

Experimental Farm, Swift Current, Sask.

Hayfield of a crested wheat—brome—alfalfa mixture

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CONTENTS

	Page
Introduction	5
Cultivated Forage Crops in Prairie Agriculture	5
Condition of Land and Preparation of Seedbed	6
Cultivated Land	6
Abandoned Farm Lands	6
Overgrazed Pastures and Native Grasslands	8
Choice of Crops	8
Grass-Legume Mixtures	8
Grasses	10
Legumes	13
Seeding	14
Time of Seeding	14
Depth of Seeding	15
Method of Seeding	15
Rate of Seeding	17
Management	18
Newly Seeded Crops	18
Hay	18
Pasture	19
Sloughs and Meadows	20
Land Preparation	20
Seeding Sloughs	20
Seeding Saline Flats and Meadows	21

PASTURE AND HAY CROPS FOR THE SOUTHERN CANADIAN PRAIRIES

M. R. Kilcher[1], R. W. Lodge[2], D. H. Heinrichs[3], and J. B. Campbell[4]

Introduction

Forage crops are important in the agriculture of the Canadian Prairies. They not only provide feed for livestock, but also play an important role in soil conservation and weed control. In recent years, acreage of cultivated forage crops has been expanded, but there is a need for more extensive seeding. Over much of the area there are depleted native grass pastures, weedy abandoned fields, sloughs, and certain cultivated lands that would give better returns if seeded down to suitable grasses and legumes.

This bulletin presents information relating to production and management of cultivated forage crops. The most suitable crops, methods of seedbed preparation, rates, depths and times of seeding and management of young and old stands are discussed. The bulletin was prepared to guide forage crop production on dryland within the Brown and Dark Brown Soil zones of the Prairie Provinces.

Cultivated Forage Crops in Prairie Agriculture

Approximately 80 per cent of the cattle in the Prairie Provinces are raised on farms and the remainder on ranches. Frequently the pastures on small farms are poorly managed and hence unproductive. Well-managed cultivated forage crops can add substantially to the productive capacity of such farms. Native grass pastures have a low carrying capacity even at their best. From 10 to 40 acres of native grass are needed to carry a cow for a six-month grazing season. Cultivated grass pastures can produce twice as much forage for grazing, while grass–alfalfa mixtures can triple or quadruple production when used either for hay or pasture.

Many farms need more and better quality roughage. Straw alone is a poor roughage for wintering livestock, and is particularly unsuitable for young cattle. On the other hand, grass–alfalfa hay is a high quality roughage feed.

Private leases, crown lands, and community pastures will produce more if forage crops are seeded wherever possible. Abandoned lands, particularly, should be sown to grasses or mixtures as soon as possible because establishment becomes more difficult each year. While much of the native grassland area may be too rough for cultivation the stone-free pastures, especially if overgrazed, can be broken and seeded to grasses and legumes.

It is often profitable to use good crop land for hay and pasture. On many farms agricultural security is dependent on a balanced year-round livestock and grain enterprise. At the Swift Current Experimental Farm, grass–alfalfa mixtures have been compared with wheat. The gross cash returns are similar while production costs are less for the forage crop. Comparisons are made in Table 1.

[1]Research Officer, Forage Section.
[2]Research Officer, Pasture Section.
[3]Officer-in-Charge, Forage Section.
[4]Officer-in-Charge, Pasture Section.

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Table 1.—Dryland Yields and Gross Returns from Grass-Alfalfa Hay Compared with Wheat at Swift Current, Sask.

	Average Yield 1939 to 1954 incl.	Gross Value**
		$ cts.
Grass-alfalfa mixture	·87 tons per acre	10 64
Wheat on summerfallow	*9·8 bushels per cultivated acre	10 80

*Wheat-summerfallow rotation where per acre yield average was 19·6 bushels.

**Value of crop calculated from current prices each year as given by The Statistics Division, Saskatchewan Department of Agriculture.

Wherever livestock are raised, the highest returns can be expected only when as much attention is given to the seeding and managing of pastures and hay fields as most farmers give to grain farming. Farmers realize the importance of good grain varieties and well-bred livestock. Well-bred grasses and legumes for their hay and pasture fields are just as important. In recent years, several well-adapted grasses and legumes have come into use on the Prairies. By selecting recommended grasses and using them in planned rotation, it is possible to produce more livestock on the same acreage.

Condition of Land and Preparation of Seedbed

The primary objective in land preparation is to secure a firm seedbed that is free from growing weeds. There are conditions where, quite apart from the cost involved, land preparation would not be feasible. Extremely rough terrain or excessively stony land would be impracticable if not impossible to cultivate and seed. However, the other lands of tillable nature, cultivated land (crop land), abandoned farm land, overgrazed pastures, and native grassland, are suitable for growing forage crops.

Cultivated Land

Very little preparation is required before seeding forage crops on cultivated land; and no preparation is needed if the forage crop is sown into stubble land during the fall. Stubble land is an ideal seedbed because the soil is firm and thus shallow seeding is ensured. The stubble also eliminates soil drifting, acts as a snow trap, and helps protect the young forage plants. If stubble land cannot be seeded in the fall, it may still be sown the following spring. However, spring-seeded stubble land may require shallow cultivation with a one-way or disk, and packing before seeding. Shallow cultivation will help control weeds, while packing will provide a firm seedbed.

Summerfallowed land is usually suitable for seeding forage crops in the spring. A light cultivation will be required to break up the surface crust and destroy early weed growth. Forage crops may be established with a cereal companion crop when summerfallowed land is used. The cereal crop should be seeded first, and the forage crop should be seeded at right angles to it.

Abandoned Farm Lands

Land that was once farmed for grain but was given up because of crop failures, or other reasons, is described as "abandoned land". Such land when left idle produces only weeds, the type of weed growth depending on the length of time since it was last cultivated. On recently abandoned land, annual weeds such as Russian thistle, tumbling mustard, stinkweed, Canada fleabane, and

various pigweeds are most common. Gradually, the perennial weeds such as pasture sage, prairie sage, goldenrod, and certain native grasses will replace the annuals.

It is much easier and less expensive to establish forage crops on abandoned fields that are in the annual rather than in the perennial weed stage. On fields in the annual weed stage, little if any cultivation is required beforehand when seeding is done during the late fall. The dried annual weeds, like stubble, will hold the snow, and will provide a firm seedbed. Fall-seeded grasses and legumes get an early start in the spring, and compete successfully with the annual weeds that start from seed.

Figure 1—On the left is a stand of cultivated grass sown into an abandoned field the previous fall.

Abandoned land in the perennial weed stage will require cultivation and seedbed preparation before sowing. The perennial weeds must first be destroyed. Plowing, deep one-waying, or Noble blading, followed by disking, are tillage practices that destroy such growth and prepare a suitable seedbed. No definite recommendation on the type or amount of cultivation will be given here, as conditions vary from farm to farm. Table 2 gives data on grass stands obtained after various seedbed preparations in tests conducted at different points in Saskatchewan. They show that plowing and one-waying gives the best results.

Table 2.—How Cultivation Affects the Success of Obtaining Forage Crop Stands

Cultivation Before Seeding	Percentage Grass Stand Obtained	
	On abandoned land covered with perennial weeds	On native grass sod
Plowed and one-wayed	85	85
Noble bladed and one-wayed	80	75
One-wayed twice	60	45
One-wayed once	50	35
Noble bladed only	35	25
Check (no cultivation)	15	10

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Overgrazed Pastures and Native Grasslands

Complete breaking is usually required to prepare sod land for seeding forage crops. Attempts to establish forage crops without first destroying the native plant growth have been disappointing. Forage crops seeded into unprepared or poorly prepared sod usually germinate, but emergence is poor and plant development is slow. Hence good yields are never attained.

Native grassland must be plowed and worked down before it is suitable for forage crops. Disk implements such as the one-way are unsatisfactory except on very sandy soil. Turning over the sod is found to be as essential as destroying the plant growth. Blade implements, (such as the Noble blade), usually kill the native plants but do not turn the sod. This unturned dead sod does not make a good seedbed. Furthermore, rain after blading tends to bring back the native growth because the sod is not turned.

Figure 2—A badly overgrazed native pasture. Before seeding this pasture should be cultivated.

Soil drifting and water erosion may be problems when preparing a seedbed. This is particularly true on light sandy land. A good practice on these soil types is to seed a cereal crop in the spring and sow the forage crop into the stubble during the late fall.

Choice of Crops

The choice of cultivated forage crops for dryland hay or pasture on the Prairies is limited. Pure stands of grasses or legumes may be grown, but mixtures will yield more and last longer than single crops. Alfalfa and sweet clover are the two best adapted legumes, while crested wheat grass, intermediate wheat grass, brome grass, Russian wild rye grass, and slender wheat grass are the recommended dryland grasses. Topography, soil type, and use for pasture or hay, will determine which crop to grow and whether to grow it alone or in a mixture. The crops suited for saline or flooded areas include tall wheat grass, slender wheat grass, and reed canary grass.

Grass-Legume Mixtures

A legume, particularly alfalfa, in mixture with grass will provide two or three times as much forage as the grass alone. Not only is the yield increased substantially, but a more complete and balanced feed is obtained. By themselves grasses usually become "sod-bound" after three to five years because of nitrogen

deficiency in the soil, and production drops sharply. In contrast, a grass–alfalfa mixture will not become sod-bound so long as alfalfa remains in the stand because the alfalfa, in using nitrogen from the air, will help maintain soil fertility. Sweet clover is less satisfactory than alfalfa because it is a biennial and usually disappears from the stand after the first crop year. However, for short rotations, sweet clover is entirely suitable.

Figure 3—Cultivated hay test plots after 11 years. Grass plots are sod-bound and produce about ¼ ton per acre. Plots including alfalfa like the one on the right, continued to produce about 1 ton per acre.

Figure 4 shows how Ladak alfalfa–grass mixtures have outyielded grass alone over a period of twelve years. The sweet clover–grass mixtures also outyielded the grass alone. The beneficial effect of the sweet clover was evident many years after it had passed out of the stand.

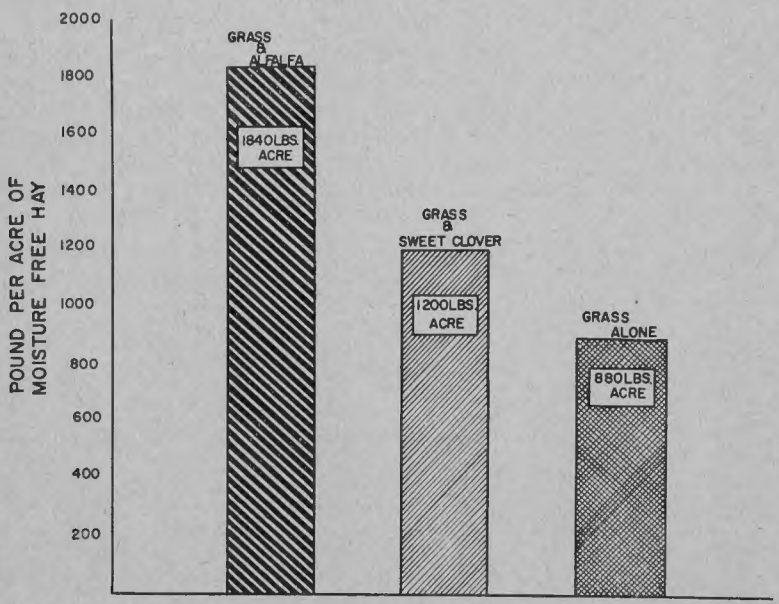

Figure 4—Twelve year (1942 to 1954) average hay production from a dryland test at Swift Current, Sask.

Some of the most useful grass–alfalfa mixtures to grow for pasture and hay with approximate rates of seeding are listed below.

Pasture

Mixtures useful mainly for rotational grazing:

Fairway crested wheat grass 4 lb., alfalfa 1 lb.—spring pasture
Summit crested wheat grass 6 lb., alfalfa 1 lb.—spring pasture
Intermediate wheat grass 10 lb., alfalfa 1 lb.—summer pasture
Brome grass 9 lb., alfalfa 1 lb.—summer pasture
Russian wild rye grass 6 lb., alfalfa 1 lb.—fall pasture

Mixtures most useful for continuous grazing:

Crested wheat grass 2 or 3 lb., Russian wild rye grass 3 lb., alfalfa 1 lb.
Crested wheat grass 2 or 3 lb., intermediate wheat grass 5 lb., alfalfa 1 lb.
Crested wheat grass 2 or 3 lb., brome grass 5 lb., alfalfa 1 lb.
Russian wild rye grass 3 lb., intermediate wheat grass 5 lb., alfalfa 1 lb.

Hay

Crested wheat grass 2 or 3 lb., intermediate wheat grass 5 lb., alfalfa 2 lb.
Crested wheat grass 2 or 3 lb., brome grass 5 lb., alfalfa 2 lb.
Crested wheat grass 2 or 3 lb., slender wheat grass 5 lb., alfalfa 2 lb.
Intermediate wheat grass 10 lb., alfalfa 2 lb.
Brome grass 9 lb., alfalfa 2 lb.
Summit crested wheat grass 6 lb., alfalfa 2 lb.

NOTE:—When crested wheat grass is included in a mixture, use 2 pounds of Fairway or 3 pounds of Summit.

Grasses

Crested wheat grass (Varieties—Fairway and Summit).—A widely adapted, early growing, extremely tough bunch grass that will survive long periods of drought. It is long-lived and has a dense deep root system. It is strongly competitive and will crowd out weeds and most other grasses. Crested wheat grass is easily established and can be seeded under a wide range of conditions. It is palatable to livestock until the heading stage, but thereafter becomes stemmy and is not relished.

If stock are kept on crested wheat grass continuously, they will do well on it even though it does become coarse and stemmy. For hay, crested wheat grass should be cut shortly after heading.

The variety Fairway has been used extensively in Western Canada for pasture and hay. It was the main grass seeded on abandoned farm lands after the drought of the thirties.

The variety Summit has been developed by the Dominion Forage Crops Laboratory at Saskatoon. It grows about four inches taller than Fairway and yields a little more in most areas. Because it grows taller, it is better suited for hay production than Fairway.

Intermediate wheat grass.—A fairly long-lived perennial with creeping root-stocks. It grows 3 to 5 feet tall if moisture is good. It is leafy, and relished by livestock. The seed is larger than that of brome grass and young plants are vigorous and grow rapidly.

Figure 5—Fairway crested wheat grass.

Figure 6—Summit crested wheat grass.

Because of its tallness, intermediate wheat grass makes an excellent hay grass, and in mixture with alfalfa, it has outyielded both crested wheat grass–alfalfa mixtures and brome grass-alfalfa mixtures at many locations in the Brown and Dark Brown Soil zones. Intermediate wheat grass matures later than crested wheat grass and is good for summer pasture. Stands of intermediate wheat grass are shorter-lived than those of crested wheat grass. Intermediate wheat grass generally does well where brome grass does well.

Brome grass.—Widely grown in Canada. It has a spreading root system, grows to a height of 3 to 4 feet, and produces an abundance of leaves on the stems. Fair moisture conditions are necessary for good performance of brome. It does well on the heavier soils of the Brown and Dark Brown Soil zones, and is especially adapted to conditions in the Cypress Hills and the Park Belt. In mixture with alfalfa, it is most suitable as a hay crop but can be used also for pasture.

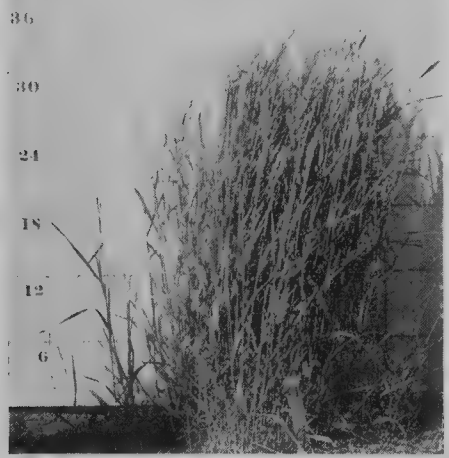

Figure 7—Intermediate wheat grass.

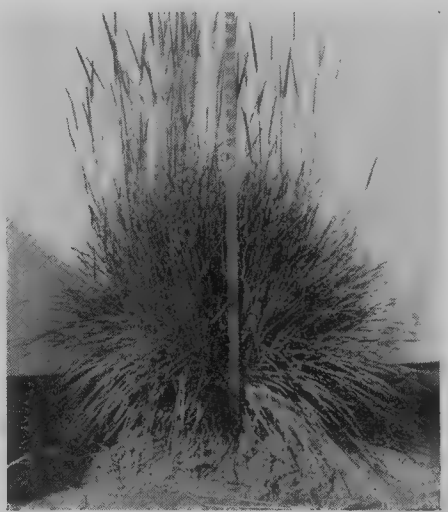

Figure 8—Russian wild rye grass.

Russian wild rye grass.—A drought-resistant bunch grass that produces an abundance of basal leaves close to the ground and few seed stalks when seeded in rows that are spaced no further than 12 inches apart. It starts growth in the spring about as early as crested wheat grass, and although it grows slowly through the summer, it retains its green color and a high nutritive value later into the season than other grasses. Its protein content after August is usually two or three times as great as that of crested wheat grass. It has very good curing qualities. Although somewhat slow to establish, Russian wild rye grass is as long-lived as crested wheat grass.

Because most of the leaf growth of Russian wild rye grass is basal it is more suitable for pasture than for hay. It has a very good recovery after grazing, which contributes further to its merits as a pasture grass. In the dry prairie area this grass fits in best for summer and fall pasture, but can be used in a continuously grazed pasture.

Slender wheat grass.—A short-lived perennial bunch grass that yields well during the first two or three crop years. After the third crop year, however, it begins to disappear from the stand. It is well adapted to heavy clay soils and does better than most grasses on saline soils (soils high in salt content). Slender wheat grass is susceptible to sawfly attack and leaf spot diseases.

Slender wheat grass fits in well in short-term rotations or in mixture with a longer-lived grass for higher yield during the first two crop years. It is one of the best grasses to seed on low-lying saline soils in mixture with sweet clover.

Tall wheat grass.—A bunch-rooted grass that grows 3 to 6 feet high under good moisture conditions. It is coarse stemmed and does not flower until the

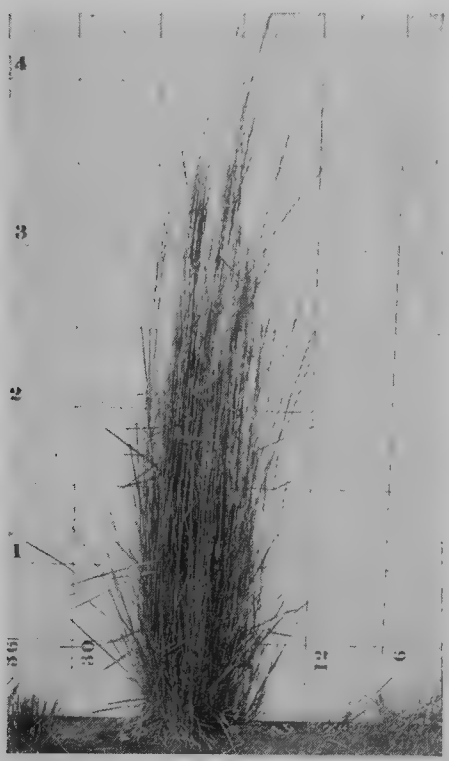

Figure 9—Tall wheat grass.

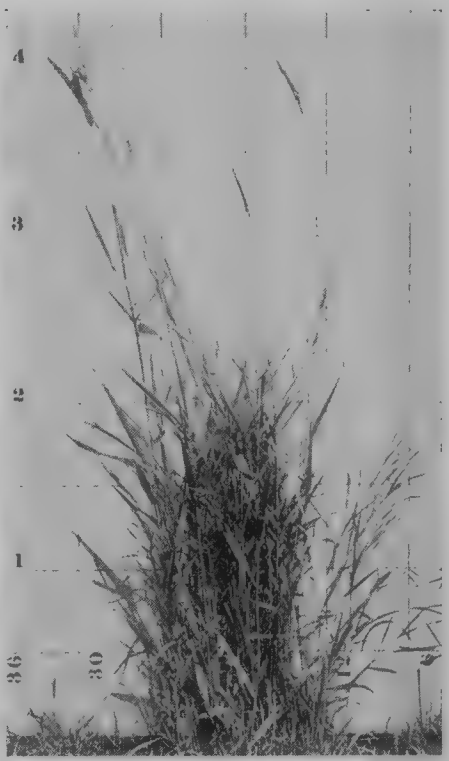

Figure 10—Reed canary grass.

latter part of July. It does best where there is some spring flooding or where there is a high water table but will not live long on dryland. Its chief value is its tolerance to highly saline soils and in the Prairies it must be regarded mainly as a special purpose grass for grassing lowlands where white salts show at the surface.

On saline wet meadows, no other grass does as well as tall wheat grass. It is high yielding and makes good hay when cut at the heading stage. Tall wheat grass is suitable for pasture at an early stage of growth, and its recovery after grazing is good.

Creeping red fescue.—A long-lived perennial that has creeping roots. Fair moisture is a requirement for this leafy grass. It is especially adapted to the Cypress Hills and Park Belt areas where it is useful for pasture.

Reed canary grass.—A long-lived hardy perennial, with strongly creeping rootstocks and many smooth, broad leaves on coarse stems. It requires wet conditions to thrive but will not kill out readily during dry periods. Reed canary grass does especially well in sloughs that are flooded for a month or two in the spring and will survive longer periods of flooding if the water is not deeper than two feet. In sloughs it will grow to a height of six feet or more and produce a very large yield of hay. Reed canary grass is not highly tolerant to salinity and should not be used in sloughs where excessive amounts of white salts appear at the surface. It can be used for pasture but grazing should be delayed until the ground is dry so that the roots will not be damaged by tramping.

Legumes

Alfalfa (Varieties—Grimm, Ladak, and Rambler).—The most commonly used perennial legume. Hardy, nutritious, and high yielding, alfalfa should not be left out of any forage crop seeding endeavor. Its inclusion in a mixture for pasture or hay will result in two to four times as much feed as grass grown alone. Alfalfa helps condition and improve the soil, which in turn helps to extend the productivity of grasses that are included in the mixture.

Most areas of the Prairie Provinces can grow alfalfa successfully. A strong, deeply penetrating root system permits it to survive drought conditions well. Of all the hazards, the most damaging to alfalfa is late summer and fall grazing or mowing. Although a short second growth may be made when used as hay, this second growth should not normally be taken off unless it can be taken before mid-August. Alfalfa requires this second growth to store the root reserve needed to survive the winter. Likewise, heavy grazing during the last half of August and in the month of September will be injurious to alfalfa. However, it can be safely used for hay or pasture after the end of September..

Grimm is a variegated alfalfa variety in which most of the flowers are purple and blue. It is the oldest variety in the Prairie Provinces and is still the most widely grown because seed is plentiful. Grimm is winter hardy, but it is not too drought resistant and often winterkills after a dry summer or fall. It is satisfactory for hay production but does not stand up well under grazing on dryland.

Ladak is a variegated variety in which blue flowers predominate but cream and white flowers are common. Ladak has a more branched root system than Grimm and is considerably more drought resistant. It is a better variety than Grimm for hay production, and in addition, survives well when grazed moderately.

Rambler is a new creeping-rooted alfalfa variety developed by the Dominion Experimental Farm at Swift Current and licensed in 1955. Its flower color varies from yellow through greenish yellow to blue. Rambler is more drought

resistant and has greater winter hardiness than either Grimm or Ladak. The variety was developed primarily for pasture use and it has good resistance to grazing. Recovery after grazing is slow, which is regarded as a desirable characteristic on dryland pastures.

Figure 11—The above mount illustrates the growing habit of Rambler alfalfa compared with that of the common Ladak alfalfa at Swift Current, Sask.

Sweet clover (Varieties—Common yellow, Erector, and Arctic).—A biennial legume that grows rapidly and attains a height of 3 to 5 feet. The sweet clover plant is coarse and thick stemmed and becomes very woody and unpalatable if not cut early for hay. After two seasons sweet clover will disappear from the stand unless reseeding by shattering takes place. Sweet clover seed must be scarified before seeding. The seed coat is so hard that only a small percentage of seed will germinate if this seed shell is not first scratched or cracked. Most commercial seed is scarified before sale. Shattered seed can lie in the soil for years before germinating. This characteristic of sweet clover causes volunteer plants and often places it in the troublesome weed class. Sweet clover is a satisfactory legume to use in mixtures with grass if the stand is to be left down for not more than four years.

Alsike clover.—A short-lived perennial legume that lacks drought resistance and is not completely winter hardy. However, it does well on peaty soils or soils with a high water table. Alsike clover is leafier than either alfalfa or sweet clover. It will withstand more spring flooding than alfalfa or sweet clover, and is the best legume to use in mixture with grass where water lies on the land for a short time in the spring. It does very well on wet meadows in the Cypress Hills.

Seeding

Time of Seeding

Forage crops may be seeded during three periods in the year, depending largely on the crop chosen, and the type of land to be seeded.

Late fall.—The late fall period extends from the third week in October until freeze-up. Only stubble, weed, or other trash-covered land should be

seeded in the late fall. Seeding may be done after freeze-up if the soil is dry enough to permit the seed to be placed into the ground. Alfalfa and all the grasses mentioned in this bulletin can be seeded during the late fall period. Sweet clover, however, establishes best if seeded in the spring. Late fall seeding is advantageous chiefly because the seeds are present in the soil early in the spring ready for germination while moisture is plentiful. This allows the small seedlings to become well established before the weeds can choke them out and before the hot dry weather of July and August.

Early fall.—Early fall is the period from mid-August to mid-September. Grass legume mixtures or legumes by themselves can be seeded during this time but success is not so likely as from late fall seeding. However, all grasses, with the exception of Russian wild rye grass, can be successfully seeded during this period if moisture conditions are good and if grasshoppers are not too prevalent.

Sweet clover and Russian wild rye grass establish slowly and will not normally make sufficient growth to withstand the first winter if they are seeded during the early fall period.

Spring seeding.—All forage crops may be seeded in the spring with a good chance of establishing a stand. It is important to sow early to take advantage of the early spring moisture. Spring seeding may be done on summerfallow, stubble land, or recently abandoned land. However, it is desirable to destroy small weed seedlings by cultivation before seeding a forage crop in the spring. Packing may also be necessary prior to seeding to firm the land.

Depth of Seeding

Failures to establish stands of forage crops are caused more often by seeding too deeply than for any other reason. The best seeding depth for most grasses and legumes is at a rather shallow level. On heavy soils best results can be expected from a seeding depth of one-half to one inch, while on light soils the desired depth is from three-quarters to one and one-half inches. A good rule for all soils and conditions is to seed no deeper than one inch. Table 3 presents the results from an experiment on seeding depth for a few crops.

Table 3.—Percentage Emergence of Some Forage Crops from Different Depths in Clay-Loam Soil

—	½ inch	1½ inches	3 inches
	%	%	%
Crested wheat grass	90	45	0
Brome grass	95	80	10
Russian wild rye grass	95	75	0
Intermediate wheat grass	90	85	5

Method of Seeding

In the prairie region, where the surface soil is usually dry, the seed must be placed into the ground to obtain germination. Broadcast seeding is not satisfactory and should be avoided unless the ground is too rough for the drill.

The ordinary double disk grain drill can be used satisfactorily for seeding all forage crops dealt with in this bulletin. On stubble or trashy land the drill disks will cut through the debris and place the seed well into the ground. On loose soil, care will have to be taken not to seed too deeply. The land should be worked down well and harrowed to firm the seedbed. Then the drill should be set shallow and the pressure springs released. The seed will then be placed at about the proper depth—one inch into the soil.

Depth control attachments that fit onto the drill disks can be used to control the seeding depth. Such attachments can be improvised or purchased for all makes of drills. These attachments are flanged plates that fit on the outside of the drill disks (Figure 12). The diameter of the depth control attachment is usually about one and one-half inches less than the diameter of the drill disk so that seeding depth is controlled from three-quarters to one inch.

Figure 12—Illustrated depth control attachments for double disk drills. The "pie-plate" one on the right is a type obtainable from commercial machine companies. The center one is a homemade flange ring spot welded to the disk, while the one to the left is made from plywood. It is designed to bolt onto the disk.

One-ways or diskers are not satisfactory implements with which to sow forage crops because they bury the seed too deeply.

Broadcast seeding may have to be done on very rough land or on small areas. A cyclone seeder, a small hand-operated machine, is useful for this purpose. If at all possible, the area should be harrowed or raked before and after seeding. Much more seed per acre will have to be sown when broadcasting because (1) it is difficult to spread the seed evenly, and (2) some of the seed will not germinate because of lack of moisture.

Mixtures of grasses and alfalfa or grasses alone produce the most pasture and hay when the rows are 12 or 14 inches apart. Row spacing tests have shown that 6-inch spacing of rows is much too close for good plant development of perennial grasses and alfalfa on dryland. When the grain drill is used for seeding, every other run can be shut off by fitting pieces of cardboard snugly into alternate cups.

The strongest and best stands of grasses and legumes have been obtained when they were seeded by themselves without a companion or nurse crop. However, when seeding on summerfallow in the spring, good stands can be established with a companion crop, provided seeding is done according to the method suggested below.

The companion crop, wheat or oats, should be seeded first in rows spaced one foot apart, and the forage crop immediately after at right angles to the grain seeding. The companion crop may be seeded at half normal rate. This will be accomplished when the indicator is set at normal rate, since only half the runs will be seeding. It is advisable to sow the forage crop immediately after the cereal has been seeded, in order not to give the grain crop the advantage of first emergence.

The important thing to remember when using a companion crop is not to mix grain and grass and seed them together. When the two crops grow in the same drill row, the stronger grain seedlings tend to crowd out the forage seedlings to a much greater extent than when they are growing some distance apart, as is the case when they are seeded separately. Seeding the two crops separately also permits each to be seeded at its proper depth.

Wheat and oats are the best companion crops. Barley and spring rye are less satisfactory companion crops because of their greater competitive ability. Flax is not a good companion crop because it tends to become infested with weeds, and because it is often damaged by spring frosts when seeded early.

Harvesting the cereal companion crop for grain is less injurious to the forage crop than harvesting the companion crop as green feed unless a swather is used. Cutting cereal crops for green feed with a mower is too harsh a treatment for the forage plants in the stand. For this same reason mowing new forage stands for weed control should be avoided.

Rate of Seeding

The rate of seeding forage crops depends on seed size, germination, and the intended use. The pounds per acre used will vary from crop to crop, but the actual number of seeds per acre will compare closely. For example, brome grass at 9 pounds per acre in rows 12 or 14 inches apart means that approximately 25 to 30 seeds are planted in a foot length of row. Likewise, when 4 pounds of Fairway crested wheat grass are seeded in rows 12 inches apart, 25 to 30 seeds are dropped per foot of row.

When seeding mixtures, it is important that the proper amount of alfalfa be used, depending on whether the field will be used for hay or pasture. When seeding a grass-alfalfa mixture for hay 2 pounds of alfalfa per acre are recommended, but for pasture only 1 pound of alfalfa per acre. The rate of seeding the grass may remain the same for pasture or hay regardless of the change made in the alfalfa rate.

Where a short-term forage crop is seeded for hay, and sweet clover is used in the mixture instead of alfalfa, 4 to 5 pounds of sweet clover should be used.

The recommended seeding rates for grasses are shown in Table 4. At these rates the number of seeds sown per acre will be approximately the same for each grass with the exception of reed canary grass which is purposely seeded heavily because of small seeds, high mortality rate and the often adverse condition of the seedbed.

Table 4.—Recommended Rates of Seeding Forage Grasses

Grass	Seeding Rate lb. per Acre 12-inch spaced Rows	Number of Seeds per Foot of Row	Approximate Drill Setting
Fairway crested wheat grass	4	32	3 pecks wheat
Summit crested wheat grass	6	28	3 " "
Russian wild rye grass	6	26	3 " "
Brome grass	9	29	10 " "
Intermediate wheat grass	10	24	6 " "
Slender wheat grass	8	29	5 " "
Tall wheat grass	15	24	8 " "
Creeping red fescue	7		4 " "
Reed canary grass	5	60	1 " "

Approximate drill settings required to seed a recommended rate will have to be determined by the operator. As a general guide, the drill can be set to sow about 3 pecks of wheat when seeding crested wheat grass or Russian wild

rye grass in 12-inch spaced rows. For intermediate wheat grass a setting that would seed 5 or 6 pecks of wheat should be about right, while brome grass will usually require a setting close to 10 pecks of wheat. After a short trial, the operator will be able to determine whether the seeding rate is nearly correct or whether further adjustment is required. The condition of the drill, the plumpness of the seed, and how well the seed has been cleaned are factors that will affect the correct drill setting for each particular seed lot.

Fluted run drills are more satisfactory for seeding brome grass than forced-feed types. Brome grass flows with difficulty even through fluted drills. Agitators built into the seed box of fluted drills have been used to ensure an even flow of brome grass seed. A man on the drill can also keep the grass stirred and the seed flowing. Some farmers use cracked wheat or other inert matter with brome grass seed to increase the weight and help the flow. If this latter method is used, care must be taken to adjust the drill setting to ensure a proper seeding rate.

Where a mixture of two or more grasses and alfalfa is seeded, the amount of each grass is usually reduced proportionately. For example, a mixture of crested wheat grass, brome grass, and alfalfa for pasture may be sown at the rate of 2 pounds of crested wheat grass, 4 pounds of brome grass, and 1 pound of alfalfa per acre. These amounts of grass are only about half the rates recommended for single-crop seedings. If three grasses and alfalfa were used, each grass should be reduced to about one-third its individual seeding rate.

Management

Pasture and hay fields are dependent on careful management for high production. The management of these fields will influence the quality of the feed, and consequently the condition of livestock.

Newly Seeded Crops

The best care that can be given newly seeded grasses and legumes is to leave them alone. Cutting with a mower to control weeds in the first year is generally harmful to the young grass and alfalfa plants because the cutting height is too short. A swather is more suitable since it can be adjusted to cut at a height of about 6 inches and thus removes the tall weeds without destroying too many leaves of the forage plants. If dead weeds need to be removed, they should be broken down with harrows or burned off the following spring before growth starts.

Hay

Grass–alfalfa mixtures will yield an average of 1 ton per acre in the Brown Soil zone over a period of years. One ton of hay per cow is not sufficient for a long, hard winter, but it will feed a 500-pound calf for 175 days or a mature cow up to 120 days.

The stage of maturity at harvest will influence the total yield. Stem and leaf growth is nearly complete by late June for most forage crops, and few pounds of feed are added after this time. Grass-alfalfa mixtures produce high yields if harvested when the alfalfa is starting to bloom, usually during the last week in June.

Early cut hay contains more protein than that cut at a later date. High protein is needed to make the best use of other plant nutrients such as starch, sugar, and fat. Good quality hay should contain at least 10 per cent protein and even more than this is desirable for milch cows and fattening steers. There is more protein in the leaves and heads than any other part of the plant, and consequently, any harvesting practice that will tend to save the leaves will

also save protein. Some important chemical constituents of feed cut at different stages of maturity are presented in Table 5. This table shows that protein and phosphorus decrease while crude fiber increases as plants get older.

Table 5.—Percentage of Nutrients in Grass Hay when Cut at Different Stages

——	Shot Blade Stage	Flower Stage	Mature Seed Stage	Late Fall
	%	%	%	%
Protein	14·0	8·0	6·1	4·1
Crude Fiber	27·6	32·7	33·6	39·6
Phosphorus	·17	·11	·09	·04

As forage crops get older, they become less digestible. The digestibility of a crested wheat grass alfalfa mixture will drop from 60 to 53 per cent if hay harvesting is delayed until mid-July. One ton of hay cut about July 1 has as much food value as $1\frac{1}{4}$ tons cut near mid-July. Mowers, swathers, balers, forage crop harvesters, rakes, and sweeps are all useful machines. But no matter how expensive the equipment, the hay may still be poor if harvesting is delayed or if the crop is handled carelessly.

Pasture

The two most important principles in managing grass-alfalfa mixtures are:

(1) Every crop needs a rest at some period each summer.

(2) Some carryover should be left at the end of the growing season.

Unless these principles are followed, production will go down and weeds will increase rapidly.

Continuous grazing.—In this system one field is used continuously throughout the season. The following suggestions are made to guide grazing rates:

(1) Provide up to $1\frac{1}{2}$ acres of grass–alfalfa mixture in the Dark Brown Soil zone, and up to 2 acres in the Brown Soil zone per cow per month. Yearlings will require about three-quarters of that needed for 2-year-olds and cows.

(2) Stands of crested wheat grass–alfalfa or Russian wild rye grass–alfalfa mixtures can be grazed when the grass leaves are 3 to 4 inches in height, while stands of brome grass–alfalfa or intermediate wheat grass–alfalfa should not be grazed before the grass leaves are from 4 to 6 inches long.

Rotational grazing.—Rotational grazing means moving the livestock to fresh pasture at regular intervals. A rotation may mean moving the livestock as often as twice daily or only once in two months. Rotations require more fencing, but to offset this expense more feed is produced, the grazing season is lengthened, crops are protected until they are ready for use, and desirable forage plants remain strong and healthy.

Grass–alfalfa mixtures that are used in rotational grazing should be simple. There is no advantage in using mixtures that contain several different varieties of grass. For example, a good spring mixture is crested wheat grass and alfalfa, a good summer mixture is brome grass and alfalfa or intermediate wheat grass and alfalfa, while a good fall mixture is Russian wild rye grass and alfalfa.

When using a rotation set-up enough land to provide forage during dry years is essential, even if this makes cutting for hay necessary during years of heavy rainfall. A late spring may reduce the rate of growth on May and June pastures, making it necessary to move livestock to midsummer fields earlier

than usual. July rains will add to the feed supply and lengthen the grazing season of midsummer pasture, which in turn assures a longer period of grazing on those kept for fall use. Three useful and flexible rotations are outlined:

Rotation No. 1.—Equal acreages of crested wheat grass and alfalfa for spring, intermediate wheat grass or brome grass and alfalfa for summer, and Russian wild rye grass and alfalfa for fall.

Crested wheat grass is recommended for spring pasture because it grows rapidly and is palatable during May and June; it can be heavily grazed during the spring if it is protected in the autumn. Brome grass or intermediate wheat grass will produce heavy crops if protected during early spring, and their leafy growth is relished until mid-August. Russian wild rye grass can be grazed at any season, but is relished more than any other grass from mid-August to November. Its higher fall protein and phosphorus contents are qualities that recommend it for fall grazing.

Rotation No. 2.—Two to three acres of crested wheat grass and alfalfa per cow for May and early June, and ten to fifteen acres of native grassland pasture from late June until November. This is really a postponement of grazing the native rangeland, allowing it time to produce a bigger crop. This rotation will increase the carrying capacity of native rangeland by about 40 per cent.

Rotation No. 3.—A rotation that is practised to a limited extent, but which could be expanded, is the crested wheat grass–alfalfa mixture for May and June, and oats, barley, or wheat from late June through September. The cereals are ready for grazing about seven weeks after seeding, and can be grazed for about one hundred days at the rate of one cow per acre. Barley will provide the earliest pasture, and wheat has maintained fall weights of sheep better than the others. However, considering the advantages and disadvantages of the three crops, oats is the best general purpose annual pasture crop. Sow the varieties recommended for the district.

Sloughs and Meadows

Sloughs and meadows are often unproductive on many farms. They may have been overgrazed, or perhaps farmed at one time, and then abandoned because of flooding or because they were too saline to grow a good grain crop. Unproductive grasses or weeds generally cover these areas. By proper cultivation and seeding the right crop, they can usually be developed into high producing hay fields.

Land Preparation

A slough or meadow must be plowed and thoroughly worked down before seeding the area down to grass. Often it will be necessary to work the land intensively during a short period because the land dries up so late in the season. Disk implements have been most successful for breaking down the plowed sod. Whatever is done, it should be kept in mind that the area will be hayed and therefore should be smooth.

Seeding Sloughs

Reed canary grass is the only crop suitable for seeding sloughs and meadows that may be flooded for more than six weeks in the spring. Reed canary grass may be seeded at two different times of the year, (1) in the spring or summer immediately after the slough dries up, or (2) late in the fall, just before freeze-up. When sown in the fall the seed lies in the ground ready for germination as the slough dries. The seed is not usually damaged by lying submerged in water for several months.

It is best to drill reed canary grass into the ground no deeper than 1 inch. Broadcast seeding is not desirable because the seed may float and wash to the slough edges. The proper seeding rate is about 4 to 5 pounds per acre in rows spaced 1 foot apart. Since the seed is small and slippery it may be necessary to mix inert matter, such as cracked wheat, with the seed to make it flow more slowly.

Well-drained meadows, where water will not collect and stand, can be seeded to a grass–alfalfa mixture for best hay. The higher edges of sloughs where water does not normally collect will also produce the best hay if seeded to brome grass–alfalfa mixtures.

Figure 13—A stand of reed canary grass in a non-alkaline slough. This stand had produced hay for 14 years when the picture was taken.

Seeding Saline Flats and Meadows

Tall wheat grass and slender wheat grass are more tolerant to highly saline soils than other grasses. Sweet clover is also somewhat tolerant and may be used in mixture with these grasses.

Although tall wheat grass, slender wheat grass, and sweet clover are described as saline tolerant, they have their limits. If some native growth or weeds are growing on the land, then these crops may also grow. If, however, the white salts are so bad that not even wild barley or weeds will grow, then these crops cannot be expected to grow successfully. Very good land preparation is required for the successful establishment of tall wheat grass, slender wheat grass, and sweet clover on meadows. These crops are not strongly competitive and it is therefore essential that all native growth be completely destroyed before seeding.

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
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